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ABSTRACT

This project examines why college women who pursued a science career for at least two years eventually changed their career aspirations. The current research evolves from a pilot study where college women considering careers in medicine used language which envisioned a future clash between the role of a physician and that of a mother. This idea of a clash of future selves is further studied in the project. College women who pursued science for at least two years before changing career goals (Switchers) were interviewed using a semi-structured interview protocol addressing such topics as experiences in science courses, science interests, supportive people, and personal aspirations. By contrast, college women still pursuing a science career in such areas as research science or medicine (Pursuers) were also interviewed. Results indicate that both Switchers and Pursuers used language of the self when discussing their career goals and when describing clashes they experienced when considering future science careers. Pursuers negotiated clashes for their intended science career through conversations with and examples set by their mentors whereas the Switchers did not seem to have examples or images of future selves and turned away from their science career aspirations to pursue other careers. (Author/AIM))

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Clash of Future Selves in College Women Considering Science Careers

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Abstract

In this project we seek to understand why college women who pursued a science career for at least two years eventually changed their career aspirations. The current research grows out of a pilot study (Packard, 1996) where college women considering careers in medicine used language describing clashing future images of physicians and mothers. We introduce the idea, clash of future selves, to help make sense of their experiences. This project explores the nature of any clashes experienced by college women considering science careers and the effect these clashes have on career aspirations. College women who pursued science for at least two years before changing career aspirations (Switchers) were interviewed using a semi-structured interview protocol addressing topics such as experiences in science courses, science interests, supportive people, and personal aspirations. As a contrast, college women still pursuing a science career in such areas as research science or medicine (Pursuers) were interviewed. Results indicated that both Switchers and Pursuers used language of the self when discussing their career aspirations and when describing clashes they felt when considering future science careers. Negotiations of clashes by Pursuers differentiated their experiences from Switchers. Pursuers negotiated clashes for their pursued science career, through conversations with and examples set by their mentors, whereas Switchers did not seem to have examples or images of future selves and turned away from their science career aspirations to pursue other careers. Implications for future research involving images of the self and mentoring are discussed.

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"Being a major scientist, or scholar for that matter, entails, I might add, enormous amounts of work and pain. And you have to accept a certain amount of rejection. You have to tolerate strong rivals. You have to be ignored for periods of time. But the idea of the lone hunter, or the lone voyager or explorer, who's guided by his principles and is going to get there against all odds, that self-image, as romantic and foolish as many people might consider it, is a very powerful force in making a major scientist."
(Scientist William D. Hamilton, from Csikszentmihayli's "Creativity")

Why would college women who pursued science for two or more years later turn away from their science career aspirations? Images of lone voyagers, and how they are incorporated into one's self-image, may indeed influence whether college women pursue science careers. In this research project, we seek to understand how such images affect women's career aspirations, not so much in the abstract, but as they actually try them on for themselves. We believe that examining images of self in the future, particularly images of self in future careers can contribute to understanding changes in women's career aspirations.

Clash of Future Selves

We introduce the idea of clash of future selves to help make sense of the experiences of college women considering science careers. In a pilot study, Packard (1996) interviewed college women considering careers in medicine to understand the factors influencing their career aspirations. Although the interview addressed such topics as experiences in science courses or the change from high school to college science environments, the women raised another issue in their interviews: they could see themselves as physicians or as mothers in the future, but seeing themselves as both physicians and mothers seemed to clash. Hazel Markus' notion of "possible selves" helped

to place these data in the context of psychological theory. Markus and Nurius (1986) introduced the notion of possible selves, that self-concept does not exist only in the present tense. People have multifaceted self-conceptions that take the form of past selves, feared selves and hoped for selves. In particular, we have future-oriented selves which motivate our behavior. This notion of "possible selves" and the results from the pilot study provided support for our introducing the notion, clash of future selves, to help make sense of the experiences of college women considering science careers. We explore how women's experience of clash of future selves affects their science career aspirations.

The Pilot Study

Exploring the results from the pilot study (Packard, 1996) can help illustrate the language of the self and clash of future selves. Accounts of "the self" seemed to leap out of the women's stories. That is, they describe very vividly conflicts they have when considering these future careers in medicine. These clashes seemed to affect their career aspirations.

One woman's experience illustrated that she was not deciding about pursuing medicine based on her interests alone. She said, "The struggle with the classes made you start thinking about not becoming a doctor, but becoming older made you think about and realize what I wanted out of my whole life, not just out of my career" (25 year old, psychology graduate student, Sherri). A nineteen year old woman in her second year of college, Andie, emphasized fewer feelings of clash than other women interviewed, and was the most enthusiastic about completing her sequence. After working closely with her father, she reported that she did not imagine that other influences such as getting married would prevent her from realizing her career goals. She said, "I'm not going to base my decision on anything like that." However, four months later she reported that she was having doubts about pursuing medicine even though she was close to completing her preparation

sequence. She said, "I don't think I am going to finish the premed sequence. I am just not as money hungry as my dad. I was thinking that I will apply for PA schools."

Two women who were in later stages of college described their perceived conflicts when envisioning lives as physicians and having personal lives as well. "That was a dream of mine since the sixth grade and which is one of the reasons why it has been so hard to give up...it's not that I could have children or a family but not to the extent I think a family should be" (Sherri). Another woman said, "I just wasn't sure if my main interest was in that field or if my main interest was having kids you know that was a dilemma that was going through my head...I think the biggest part has been the time constraints if you think you are not going to have a life besides the career." (21 year old, college senior, Ali).

In these excerpts, women discuss wanting to become mothers and wanting to become physicians. The further they became invested in pursuing careers in medicine, the more they thought about what they wanted from their whole lives. We wanted to continue research in this area to explore how these clashes influence career aspirations. First we will examine how the research literature can help make sense of why these women experienced clashes, by examining the nature of these clashes.

The Nature of Clashes

Negative Consequences to Their Relationships With Others

Many women may experience feelings of conflict when envisioning themselves in a future science career because of the perceived impact that will have on the relationships in their personal life. Gilligan's (1982) research on women's moral development provided insight for ways women may decide about careers based on factors other than interests or competence in the field. Gilligan found that women often made decisions while seeing people in a network of relationships. Instead of viewing individuals as isolated units, they discussed the potential consequences of one individual's actions on someone else. Women may consider how relationships may suffer as a result of pursuing certain science careers;

this is a potential reason for why women may experience feelings of clash when envisioning themselves in future science-related careers. Clashes may arise when imagining the negative consequences the career will have on relationships with others. Another related clash women may experience is imagining themselves as professionals in science who are isolated or too busy for their families because they are so consumed by their work.

Images of Isolated Professionals in Science who are Consumed by Their Work

Stage and Maple (1996) interviewed graduate women who turned away from math careers after completing at least an undergraduate degree in mathematics. Images of mathematicians reported by the women were often negative, and were associated with being isolated. Documenting these negative images can help understand why some women feel clash of future selves. For example, some women in this study found difficulty in conceiving of themselves as women, mothers, wives, and mathematicians. In addition, many of the graduate women they interviewed had no idea as undergraduates what they might do with their degree in math besides being a teacher or an actuary (and they did not know what an actuary did). Their limited notions of future careers may have encouraged them to rely on stereotypes to fill in the gaps of knowledge.

Eisenhart, Finkel, and Marion (1996) builds on this point by stating that underrepresentation of women and girls in science is influenced by the mass media's stereotyped portrayals of scientists as "nerdy, male and White" (pg. 272). Frieze and Hanusa (1984) describe this clash as choosing between being "feminine" or being "scientific". Mitroff, Jacob & Moore (1977, cited by Frieze and Hanusa) reported that stereotypically, scientists are perceived to spend long hours in a lab, a perception that may lead women to believe they would have to sacrifice social interaction. For many students this may present a strong clash of identity if they feel they are too different from the images of this career.

Research in professional contexts have documented that professional labels, such as "Techies," are often incorporated into people's identities (Kunda, 1992). Women who are considering science careers may find it difficult to incorporate professional labels into their self image if their conceptions of scientists are stereotypical. For example, common perceptions of the man in a white lab coat locked away in his solitary lab, and the doctor who is a slave to the hospital and always "on call" that are persistent in society may influence women's career aspirations.

How People in the Science Field Influence Images and Their Development

We have given examples illustrating how media and stereotypes inform women's science career images. In addition, women's examinations of individuals in science communities may inform their career images. What exactly do they look for and how are their images informed through interactions with others? Other people (e.g., peers, parents, mentors) influence the development of these images because they provide examples of people in the career. As Gilbert and Rossman (1992) wrote,

> Women today are struggling to define themselves and to create new images of themselves as women, ones that allow a number of different patterns, ranging from the integration and coexistence of achievement and family life to the choice of one over the other (Baruch, Barnett & Rivers, 1983). A number of studies of graduate students in psychology concluded that female students were looking for other images and alternative destinies for themselves and were looking to the lives of other women for evidence of other possible selves (e.g., Gilbert & Evans, 1985; Pierce, 1984).

By examining the lives of other people such as peers, mentors, and professors to inform the images they have for future careers, they may subsequently try on these images for themselves as they consider science careers. Reinharz (1979) said, "As soon as the fateful choice was made [to become a sociologist], I began to examine my role models-- Mirra Komarovsky, Renee Fox, Phillip Zimbardo, Alan Blum, Roberta Simmons, Gladys

Meyer, and Amitai Etzioni among others. These were the people who represented the 'future me'" (pg. 51). Depending on the role models available to women, these images can be based on stereotypes or relationships to real professionals in the field. This research examines how women's relationships with people in science inform their career images and affect their science career aspirations.

How Prior Research Has Addressed Women Leaving Science Pipeline

For decades researchers have examined reasons why fewer women are found in the science "pipeline"; Eccles (1987) studied the decline of girls' interests in junior high, Baker (1987) studied high school women's views of themselves as science students, and others have studied the function of peer socialization in college women's career-related decisions (Holland & Eisenhart, 1990). Although this research adds to our understanding of underrepresention of women in science, there has been a lack of research dedicated to tracking women as they leave the science pipeline, particularly in the later years of college when students are more likely to be seriously considering careers.

Losing interest in science, although commonsensical, may not be the reason some women use to explain their departure from science careers. Lips (1993) found that college men's self-described interests in physical sciences were predictive of their perceived strong likelihood to pursue a career in the field. However, women's self-described interests in science were weakly related or not related to their perceived strong likelihood of pursuing a career in science. Lips suggests that other factors besides self-perceived interest are critical in students' career choices. The current research explores the possibility that clash of future selves is a conception for why women with strong interests in science and who have made strong investments in science do not pursue science careers.

One conception of why women leave science during college that has been supported in the research literature is the unfriendly, competitive, disconnecting atmosphere stereotypical of science classrooms. Eisenhart et. al (1996) reported in their review of the

literature that students may feel disconnected to science classrooms and the content taught in them due to their "chilly climate" (e.g., Tobias, 1990; Sadker & Sadker, 1994). This research project will address women's experiences in science courses to see if they describe the chilly climate as having affecting their career aspirations. Because the chilly climate is used more often to describe precollege and introductory college science courses, the chilly climate may not be the only reason used to explain their departure because the women studied in this research have already surpassed introductory courses. Given the dramatic nature of their decisions to switch career aspirations after such an investment in preparing for a science career, this project serves to explore other conceptions for these women's decisions.

Focusing on the Self Can Contribute To Understanding Experiences of Target Population

The current research project is a continuation of research examining why women "turn away" from science during college. Research in this area can contribute to the broader research literature because it is different from research on students who have not expressed interests in nor made investments toward pursuing science careers. Turning away refers to when women who have exhibited interest and success in science (through taking courses and expressing interest in a science career) switch college majors and change career ambitions, thereby turning away from their initial science-related careers. As explored by Tobias (1990), students who are smart, competent, and motivated and succeed in other areas may never enter science careers because they are not engaged by science, particularly in the introductory sequences. However, many participants in Tobias' (1990) work had not made a significant investment toward pursuing a science career at any time in college (which is why they had not taken an introductory science course until their participation was solicited by Tobias). Participants in Tobias' work could be thought of as turning *toward* another career rather than turning *away* from science. In the current research, it is anticipated that women experience a conflict because the women have pursued science for

many years until they dramatically change career aspirations during their last years of college. This research thus explores the notion that women are turning *away* from science rather than turning *to* another field noting that some change has occurred. There is a lack of previous research that has examined the experiences of students who make such an investment toward a science career and eventually leave the science pipeline; in this project women who have recently left the science pipeline are interviewed to further understand their experiences.

Another limitation of prior research is the lack of emphasis on images of self and their influence on career aspirations. Our research explores the experiences of these women considering science careers to see how they explain their departure from science careers and also their pursuit of such careers. How do they discuss their career aspirations-- in terms of interests, grades, or climate? Because the women in this research project had made such an investment (two or more years) toward a science career, persisting beyond introductory science courses, we expect that exploring issues of the self in addition to the factors explored in prior research will contribute to our understanding of the factors influencing their career aspirations.

Research Questions

This research seeks to explore why these college women turn away, sometimes dramatically, from science careers they aspired to, and how their experiences are similar to and different from women who are still pursuing science. Specifically, 1) What is the nature of any clashes these women experiencing when considering science careers in the future and how do they affect their career aspirations?, and 2) What differentiates the experiences of the Switchers and Pursuers? Switchers and Pursuers are used when discussing the participants. This terminology is preferred over the "science career persister-nonpersister" terms that are more commonly used. Persistence tends to a positive connotation and thus nonpersister has a negative connotation; "Switching" more accurately

denotes the "turning away" phenomenon that was discussed in the introduction without adding any negative value judgment to their decisions. Likewise, "pursuing" describes the other women's current states-- that they are pursuing a science career.

Method

Participants

Participants were college women attending a large midwestern university. The women ranged in age from 20 to 23 years old.

Procedures

Instructors of undergraduate and graduate courses were contacted to ask permission to solicit volunteers from their courses by distributing a short survey assessing students' college major since attending the university. Potential participants completed the survey and indicated that they were willing to be contacted to schedule an interview. Five college women who were majoring in science and planned to pursue a science-related career (e.g., medicine, genetic research), and five college women who had pursued a science career for at least two years but later changed career aspirations were interviewed. Interviews took approximately one hour and participants were compensated a nominal amount for their interview time. The semi-structured interviews (see Appendix A for interview protocol) were audiotaped. Audiotapes were transcribed and analyzed.

Results

Overview

First, descriptive information about each group is presented (e.g., years invested in science and careers pursued). Next, summary information about the women's experiences is presented for all participants (e.g., who had a parent, mentor, or work experience in science). Finally, to expand upon results in these sections, examples from the women's interviews are presented to offer a flavor of what the women said in their interviews, in terms of using language of the self, clash of future selves, and negotiations of clashes.

Information by Group

Information about participants are displayed below (see Table 1a and 1b), with information about Pursuers and Switchers displayed separately. Short case summaries are available (see Appendix B). Notice that all participants had invested between two and four years in science. Most described themselves as doing well in their courses. The grade point averages that were available are displayed in the table. In this overview, participants appear basically comparable across groups.

Table 1a: Pursuers

Name	Cameron	Autumn	Dawn	Jessie	Stephanie
Years Invested	3 years	4 years	3 years	4 years	3 years
GPA	3.65 overall 3.5 science	3.85 overall 3.8 science	3.8 overall 3.9 science	3.1 overall 2.75 science	3.66 overall science n/a
Career currently pursuing	Veterinarian	Physician	Researcher	Chiropractor	Physician

Table 1b: Switchers

Name	Elizabeth	Kari	Shelly	Betsy	Allison
Years Invested	2 years	4 years	4 years	3 years	3 years
GPA	3.7 overall, 4.0 science	"did well" specific n/a	"did well" specific n/a	3.75 in ed. 1.5 science	3.6 overall 3.5 science
Career before switching	Environmental Scientist	Physician/ P.A.	Airforce (Science)	Marine Biologist	Mechanical Engineer
Switched To	English	HS Biology Teacher	HS Biology Teacher	Elementary Ed. (Nonsci)	Elementary Ed. (Sci)

Information across Participants

Next, information for all participants are listed in one table (see Table 2). The table indicates whether participants spoke of having a mentor in science (e.g., a family friend, professor or physician they worked with), work experience in science (e.g., working in a research lab), an influential elementary or secondary teacher as a role model (e.g., someone in their educational experience or else as interns), and their peer group in science.

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Table 2: Summary of Experiences (P=Pursuer, S=Switcher)

Name	Science Mentor?	Science Work Exp?	Influential Teacher?	Parent in Science?	Science Peers?
Cameron (P)	x	x		x	x
Autumn (P)	x	x		x	x
Dawn (P)	x	x			x
Jessie (P)	x	x		x	
Stephanie (P)	x	x		x	x
Elizabeth (S)			x		
Kari (S)		x	x	x	x
Shelly (S)			x		
Betsy (S)			x		
Allison (S)		x	x	x	

Pursuers were more likely to have a mentor, parent, peer group, and work experience in science whereas Switchers were more likely to mention an influential elementary or secondary teacher they had in their educational experience. These elements will continue to be highlighted in the next section where excerpts from interviews are presented. Three themes from the interviews are presented, with excerpts from interviews: language of self, clash of future selves, and negotiating clashes.

Language of Self

Language describing images of self in the future helps show why people switch and also why they stay. Women noticeably used language of "self" (e.g., "I see myself", "That's just not me") to talk about their experiences and decisions surrounding careers. Language of the self helps show why people turn away from science careers and also why they choose to stay. Examples from the interviews illustrate women using language of the self, providing compelling support for following this line of inquiry (see Table 3). Notice how they use language when reading these excerpts.

Table 3: Language of Self

Pursuers	**Switchers**
Can you think of an image of a vet...how do you see yourself as similar or different? My father comes to mind almost immediately, but there's also my grandfather too...Yeah I guess I see it as someone who has his job and it comes home with him but he likes his job so the fact it comes home with him doesn't bother him...**I see myself** easily fitting into that because I have all my life. (Cameron)	*You talked about the competitive classes, the classes you took, especially in NY, were the classes competitive or were the people competitive?* I think the people who are premed or hard-core science, I guess just by nature, they have to make the grade. And if you have to step on Joe Schmo to make the grade well that's okay. And **that's just not me**. (Kari)
Can you take your image of a doctor, and of yourself, and tell me any similarities or differences? I want to have the option, as I have gotten older I have realized I don't want to eliminate the chance of having a family, I want to have a well-rounded life, which is something I don't see in research...I think I will have control over my own work. This person? It requires long hours, it requires, I think sacrifice, self-sacrifice, your life will revolve around your career, and **I can see myself** living with that. (Stephanie)	*The money wasn't a factor?* I would rather be happy than have all that money...I hated everything you had to do to prepare for it, networking, I hate doing that, people would all be schmoozing, and **I am just not that type of person**, and people would say, "you gotta do it." (Allison)

When reading these excepts, one gains a sense of how they use language of the self to discuss their career aspirations and how they see themselves fitting into career images. These examples give a flavor of the language they used and also how the women seem to be trying on these career images for themselves as they look within the science community. The next section further illustrates this when describing women's experiences of clash of future selves.

Clash of Future Selves

Clash of future selves helps to understand why these women do not continue to pursue certain careers, such as medicine or research science. Women use language of the self to describe images of others in the field and appear to be "trying them on" for themselves (see Table 4). When reading, notice how both Pursuers and Switchers describe clashes they are experiencing when envisioning themselves in these future careers.

Table 4: Clash of Future Selves.

Pursuers	**Switchers**
Are you happy with what you know (in research)? The research I am doing; I like doing it (pause) but there is something lacking. It is not hands on enough for me. **I cannot see myself doing it for the rest of my life**, at least not in this capacity, not how I see graduate students doing it. I am also looking at it, going, part of the reason why I chose vet school is **I'm looking at the grad students** and I am thinking, I don't want to be 28 years old and still trying to get my Ph.D. in biochemistry (Cameron)	*What kind of advice could you give [a woman interested in medicine)to help her ?* **I just think medicine becomes your life**...so you are looking at 12 or 13 years that you are **devoting to medicine and not your family.** *(Don't you think you have to give a 100% in teaching?)* But in teaching they don't call me at 2 in the morning and say I really have a problem with this lesson plan, could you come in? When 3:30 or 4 o'clock rolls around I can go home if I want. I don't have to stay there. If I am a physician, and my patient is dying, I can't leave. But yet my son or daughter might be in a recital and I am going to miss it. (Kari)

What do you think about a career in research? Honestly, I don't know if there's enough people around, the reason why I like health care is that I like a lot of people coming in and out of my office and I don't think that would happen with research. *Why do you think that?* **I have these pictures of research people**, when I work at the Science Building, **there are some weird people, you know they don't go home**. I want to have my career and I want to have my life too. (Jessie)	*Could you talk about what interested you in science, and would you say you lost your interests in science?* Ummm no not at all. I have a more social interest in science, more like natural resources and things. **I can't see myself you know maybe working in a lab by myself with these little vials and not connecting with people**. If I could protect natural resources and work with people that is why I was interested in biology to begin with. (Elizabeth)

These excerpts illustrate women's experiences of clashes, ranging from seeing research as requiring isolated "weird" people working with "little vials". In addition, becoming a physician creates an image of being called in at all hours and not devoting life to your family. Interestingly, both Pursuers and Switchers had images of careers in science that influenced them to experience clashes when imagining themselves in that future career. If both Pursuers and Switchers speak of the self when discussing career aspirations and both experienced clashes when envisioning science careers, what differentiates their experiences?

Negotiating Clashes: Mentors Provide Visions of Possibility

One important different between these women's experiences becomes clear when examining Pursuers' interactions with mentors (see Table 5). Mentors seemed to provide visions of possibility to the Pursuers that helped women to negotiate clashes they were experiencing. Pursuers negotiated clashes they felt in medicine and research science through conversations with and the example set by their mentor, role models, others in their networks of support (including parents and peers) leaving them feeling supported and

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their presence in the field validated. Switchers usually did not have these mentors or parents in science, nor peers or a network of support who could potentially help negotiate feelings of clash and help validate their presence in the field. These excerpts demonstrate that it is not simply either having a mentor or not having a mentor but rather the act of negotiation that was helped by the mentors.

Table 5: Negotiating Clashes

Pursuers	**Switchers**
But you had professors in classes that were not that good, you were turned down by a family friend to work with, what kept you going? I don't know, especially when the doctor (male family friend) told me no, I was really discouraged. *What will be the biggest struggle?* **I think the biggest struggle will be balancing the patients and balancing the family...The physician I worked with that summer she was incredible, she sat me down several times and said this is what you are getting into.** I want to lay this all out on the table for you. I am a female in medicine, I have a family and I don't get to see them very much. Here is how much time I am devoting to my work, and here is how much time I am devoting to my husband and child. **And I just want you to know everything before you get into this, it is manageable but it is hard work.** (Autumn)	*What do your friends think about you as a teacher instead of a marine biologist?* I think they always thought I would be something normal like a teacher because they don't see marine biology as normal. When I see them now, they ask what I am doing, they say oh you are not in marine biology, and they just kind of chuckle. (*How does that make you feel?*) In a way it ticks me off because I really was serious about it. **In a way I think how could I really have ever been serious about it? If they view me that way and they thought it was that funny the whole time, what was I thinking even trying it, you know?** I think more often than not, it ticks me off because I really do feel strongly about it, **and really do wish that I had kept on and just been like I don't care what you people think I am just going to do it**, despite the experiences I have had with you. It can go either way with insecurities because I feel like I haven't accomplished my goal. (Betsy)

I had the hardest time getting letters of recommendation from him (male advisor), he ended up refusing to write them for me for graduate school... *How do you keep going when you get frustrated?* **I have a lot of other people I can go to, I have my mentors in the lab.** I have other advisors, they help out, they say this isn't appropriate, or they talk to them or they fix the situation, but I shouldn't have to worry about it that this shouldn't have happened but I am lucky to have a network of other people when things go wrong. (Dawn)	Ever since I was a little kid I have also always wanted to go into the air force. I wanted to go in after high school for some reason the recruiter didn't like me-- he would make appointments with me at my house and not show up. *Has there been somebody who really stands out in your mind who...anyone you worked with at all?* I really can't think of anybody. *Do you use the word mentoring?* I really don't think I have ever had one. I have always just wanted myself to do well. **I just don't have a mentor.** (Shelly)

These excerpts illustrate the women's struggles dealing with being women in science fields, facing rejections from male advisors and recruiters, others not believing in them, and struggling with how to balance family and careers. Pursuers faced rejections as well but they had other people to go to-- mentors in the lab for Dawn or a woman physician Autumn eventually worked with-- to help them negotiate clashes (such as believing they will be isolated/rejected, or not be able to have family and a career). The Switchers on the other hand were left with these aspirations still strong inside but did not have others validating their presence in the field or helping them to negotiate clashes they experienced (feeling that they were so "different" they did not belong in the field). The passion of their words and the power of these clashes of self came through in their interviews as strongly as the power of the negotiations with mentors.

Discussion

Images of self in future careers provide valuable information when understanding the experiences of women considering careers in science. Clashes of future selves is a useful notion for understanding why women change career aspirations and also why they choose to stay. Both Pursuers and Switchers used language of the self and described clashes of future selves. Relationships with mentors (or lack thereof) affected the experiences of all of the women. This study shows a dramatic difference in their experiences was the resolution of clashes for Pursuers through discussions or advice or examples set by mentors/role models in their science experiences.

Pursuers could see themselves fitting into their career as a professional in science. The Switchers, on the other hand, did not feel similar to their peers in science nor did they have a relationship with a mentor in science. Thus, when faced with doubts or conflicts, there was not someone there to tell them they belonged in science or help them negotiate the clashes they experienced. Their excerpts showed that they believed that they could not go into particular science careers without having doubts about belonging or feeling they would have to sacrifice their family or personal life for the career.

An interesting observation was that Switchers mainly switched to education/teaching in some capacity and they mentioned having role models in that field. This potentially supports the power of feeling a part of a community and having role models whom you identify with. Others who have lives like you would like or else help you negotiate your concerns with the career you aspire to can be valuable in retention efforts.

This project expands on the results from prior research. These results indicated that Switchers did not lose interest in science. They in fact spoke enthusiastically about their strong interests in science. Thus, not all women who leave the science pipeline do so because they lose interest in science. But, they did have conflicts with the career images and what life would be like as someone in that career. Results indicated that Switchers

indeed experienced a chilly climate. But more specifically, they did not feel a part of their science community, and did not feel similar to their peers and professors.

Contrary to some common conceptions, Switchers did not use their performance in courses to explain their departure. In fact, many of the Switchers were doing well in their classes. This provides more support for alternative explanations for why women turn away from science, namely, examining the role the self plays in their career decisions. Four of the five women specifically mentioned possibly coming back to science in the future. Thus, this conception is not strongly supported by these results.

Implications

Interventions Involving Mentors and Multiple Images

Interventions that 1) expose women to multiple images for people in science careers, 2) give opportunities to see how women in science or medicine negotiated some of these clashes, or 3) offer opportunities for women to develop relationships with mentors or otherwise gain valuable work experience in the context of a research team or other community of science professionals would seem to be important for women as they delve deeper into a commitment to science career. These interventions could be targeted in the second or third years of college, when women may be contemplating turning away from science.

Guidance Counselors or Academic Advisors

Not all Pursuers had always wanted to do the career they were pursuing. In fact, a few discussed other possibilities that would have been along the lines of what they would want in a career but they either lacked the prerequisites to pursue it since they did not have the career information early enough to be prepared. There was a resounding negative or neutral feeling towards guidance counselors and academic advisors from both groups of women. While many of the Pursuers had family contacts or early support systems by means of a research team or mentoring program, many of Switchers did not. In fact in

these interviews, the women more often had to really think about anyone who had been influential in their career planning. And more often this would be an elementary school or high school teacher who had been the last really influential person in their science career aspirations-- the same careers these people opted to switch to. In fact the most influential people for these Switchers were teachers-- not from college-- but from their early years, people they could want to follow in their paths. More sensitivity and awareness on the part of guidance counselors and academic advisors is necessary.

Future Research on Images of Self in the Future

Further research should follow individuals as they leave the science pipeline and document the reasons they use to explain their departure. Future research projects can investigate the particular modeling and mentoring processes involved in successful mentoring. In addition, it is important to further study the processes involved when women compare themselves to others in the field and to see how they try on such images particularly when their information about careers or connections to professionals in the field are limited. Through understanding how these images of future careers are formed, how individuals interact and learn from mentors, and how clashes of self are negotiated, we can learn more about women's underrepresentation in science as well as about potential interventions.

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Appendix A. Interview Protocol

General questions
What are your career aspirations?
What made you decide to (switch out of/stay with) science?
How did you decide you wanted to be [the science career]?
Where did you get your career information?

Courses
How much of your decision has to do with your experience in courses?
If you can distinguish between science courses and format and science subject matter, could you talk about your experience with science subject matter?
[Do you feel you have a handle on the content? connected?]
How do you feel about science subject matter compared to other subjects?
How is the teaching alike or different in science compared to other courses?
What words or phrases come to mind when you envision the science field?

Supportive People
Which people have been supportive in your career aspirations?
Do you have a mentor in this field? [Is that person a role model?]
Can you talk more about your relationship with them?
[How have they been positive? Do you identify with them?
How do they support you? Have you worked with them?]
Can you think of someone who fits that description, and talk more about how you see yourself as alike or different from them?
Have you had any significant negative or positive experiences with people in your field that stand out in your memory, such as with one of your professors?
Have you gained work experience in your area?

Personal Aspirations
What do you envision yourself doing in the future?
(e.g., children, marriage, becoming a professor)
Do you anticipate any conflicts in achieving these visions in your future, or do they look pretty consistent to you?
Have your decisions to switch to another field been influenced by what else you want for yourself in the future? Can you talk more about how you planned to balance these things?
[Other people just like you have felt these things, but they turn away from science, why do you think they do that?]
Have your peers supported your science aspirations?
What do (did) they think of you as [chosen science career]? How about as something else (new field)?
How about Your parents? What do they think about your new career aspirations?

New field vs. old?
I am sure everyone considers other fields. Can you talk more about other careers you have considered and why the one you have chosen is more appealing to you?
What makes the science career different than other careers?
Do you envision any problems in the workplace (discrimination, not being supportive of having children)? If yes, how do you plan to handle that?
What benefits do you expect from your career?

Appendix B: Short Case Summaries of Participants

Pursuer 1: Cameron
Cameron described her family of veterinarians, namely her father and grandfather. She immediately mentioned the research she has been involved in for the past three years, and how she had a strong relationship with her mentor. With her research experience and five years of experience working in her father's clinic, she feels very confident about her becoming a vet. She considered research in biochemistry but does not want to be 28 and still pursuing her Ph.D.; she said she likes the benefits of becoming a doctor after four years and how it will be flexible for having a family. As she said, she has grown up with the rigor and schedule that a vet has and she can see herself fitting into that.

Pursuer 2: Autumn
Autumn came into college knowing she wanted to be in science but was not thinking about becoming a doctor. She liked the challenge of the research in her labs (from classes) but she needed more people interaction. Her friends were premed and so she considered becoming a doctor since she was already majoring in science. After a discouraging incident where a family friend turned her down for a summer internship, a new woman doctor in her town was more than willing to work with her. She worked very closely with this woman, who went out of her way to talk to her about being a woman and a doctor. Autumn was concerned about having a family and being a doctor but she says that this woman's advice along with talking to her mother about the value of an education really helped her. These experiences and her experience of working in a hospital solidified her commitment toward becoming a physician.

Pursuer 3: Dawn
Dawn spoke almost immediately about her mentor in her research lab. Dawn began doing research her freshman year and has worked with a woman who spent extra time getting her up to speed in the lab and has answered any questions that she has had. Her enthusiasm when talking about the discovery in research was powerful. She had considered doing research with plants but decided she needed to use science to help people. This is why she mainly became interested in human genetics research. Although neither of her parents are in science, they have been really supportive of her interests. Her interests were sparked when she went to this summer program in high school on genetics and she talks about Barbara McClintock as being a good role model for her.

Pursuer 4: Jessie
Jessie's interests in chiropractic medicine were sparked by a visits to a family friend who is a chiropractor. She knew she would go into science, especially biology, because her personal interests and her science interests are very similar. Many of her friends left science and she has had some struggles in her classes. However, her father, an engineer, told her that he too had struggled in math and science but now she has seen that he is very successful, and this encouragement helped her see that much learning occurs on the job later. Jessie seems very concerned about how to balance a family and her career; although she feels close to this family friend she is searching for a woman chiropractor so she can find out how women manage this. She also seemed to be contemplating biology research. The dream job she described comes from a movie about a man who does research in the rainforest looking for a cure for diseases. She plans to do research before she goes to chiropractic school to rule out that the job would indeed be too monotonous for her.

Pursuer 5: Stephanie
Stephanie describes her work in a biochemistry laboratory. She fondly speaks of her mentor, a woman who recently received her Ph.D. in biochemistry. However, Stephanie perceives this mentor to be "different" from others in science and this relates to is why this

mentor has struggled so much in the field. Her boss in the lab who is consumed by his work demonstrates the life of a scientist. In her eyes a good scientist is someone who cannot have success at work and at home at the same time. Her father, a physician, has shown her that a physician has more control over the hours devoted to the field because she would be compensated financially for her time.

Switcher 1: Elizabeth

Elizabeth described her deep interests in the environment in her interview. As an environmental scientist, she wanted to write and publish what she found, not spend so much time out doing field work. However, she says that she would like to find a way to combine English and science; she is quick to tell me that she may return to science one day after she completes her BA. Without a mentor or parents in science, she did not have actual interaction with an environmental scientist. As she said, it was not a particular person but rather a social interest in science that influenced her to initially pursue environmental science. She is not particularly sure what she can see herself doing with English, perhaps teaching, even though she said she never envisioned herself as a teacher.

Switcher 2: Kari

Kari spoke about needing to choose a career. She did not want to wait five years for PA school and she did not feel she could be as dedicated as needed for medicine. When asked about a career in medicine, she believed that one needs to put life on hold for ten years at least and if someone is not willing to do that, then they should choose another career. Both of her parents are chemists yet she had never been to work with either of them, nor can she cannot speak of a mentor in science. She spoke of experiencing a traumatic first year of college in the premed sequence. She felt that the premeds are very competitive and they step on people if necessary, and she is not like that. Overall, she seemed to be very happy with her choice of teaching because she feels her personal goals are the same as the goals she has as a teacher.

Switcher 3: Shelly

Shelly opened her interview describing how she has always wanted to be a teacher, from the time she was younger. She found her college science classes to be too large and she felt overwhelmed by the premed people who stuck together. An important factor in her educational trajectory is financial support since she has to support her own education. Thus, she never really considered medicine because of the financial burden she had already incurred from undergraduate expenses. Near the end of the interview, she revealed that she had always wanted to go into the airforce for science since she was young. However, after high school when she wanted to enlist, a recruiter would not show up for her appointments and in college ROTC took up too much of time (she needed to spend that time working). At this time she is planning to enter the airforce for a couple years, after completing student teaching-- before beginning her teaching career. However, she is not receiving support from peers and others who have always seen her becoming a teacher and who do not understand her need to do this.

Switcher 4: Betsy

Betsy described teaching as her second choice to marine biology. She did not feel that she was a "superteacher"-- in fact she felt her lack of ultimate enthusiasm may be inadequate for her students. She had always wanted to be a marine biologist and speaks painfully about the poor guidance she received from the academic advisors, how she was passed over by her professors, and how even her peers never took her serious. She still envisioned an opportunity to go back to school for marine biology at another time; receiving a degree in education if anything could help facilitate that move for her. Her enthusiasm and obvious zest for marine mammals made her believe that she was aspiring to the right field-- she was

consumed by the idea of marine life and research. However, she said she was unlike marine biologists because they want to do "the whole thing" referring to the struggle and defeat of the path to that career.

Switcher 5: Allison

Allison declared engineering as her major because she was good at math and science in high school, not because there was someone she knew who had a job that she wanted to have. Even though her peers were not in science, she describes a very positive experience in her engineering classes, which involved extensive collaboration. During her engineering internship she realized what she would eventually be doing was a lot of "schmoozing" and business-- things she did not want to be doing that the rest of her life. Although she cannot say she has had a mentor in science, her father, a scientist, and her mother struggled at first to accept her decision to switch out of engineering. She finds herself to be much happier in elementary education where she has a chance to make a difference and do different things each day.

Clash of Future Selves in College Women Considering Science Careers

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Abstract

In this project we seek to understand why college women who pursued a science career for at least two years eventually changed their career aspirations. The current research grows out of a pilot study (Packard, 1996) where college women considering careers in medicine used language describing clashing future images of physicians and mothers. We introduce the idea, clash of future selves, to help make sense of their experiences. This project explores the nature of any clashes experienced by college women considering science careers and the effect these clashes have on career aspirations. College women who pursued science for at least two years before changing career aspirations (Switchers) were interviewed using a semi-structured interview protocol addressing topics such as experiences in science courses, science interests, supportive people, and personal aspirations. As a contrast, college women still pursuing a science career in such areas as research science or medicine (Pursuers) were interviewed. Results indicated that both Switchers and Pursuers used language of the self when discussing their career aspirations and when describing clashes they felt when considering future science careers. Negotiations of clashes by Pursuers differentiated their experiences from Switchers. Pursuers negotiated clashes for their pursued science career, through conversations with and examples set by their mentors, whereas Switchers did not seem to have examples or images of future selves and turned away from their science career aspirations to pursue other careers. Implications for future research involving images of the self and mentoring are discussed.

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"Being a major scientist, or scholar for that matter, entails, I might add, enormous amounts of work and pain. And you have to accept a certain amount of rejection. You have to tolerate strong rivals. You have to be ignored for periods of time. But the idea of the lone hunter, or the lone voyager or explorer, who's guided by his principles and is going to get there against all odds, that self-image, as romantic and foolish as many people might consider it, is a very powerful force in making a major scientist."
(Scientist William D. Hamilton, from Csikszentmihayli's "Creativity")

Why would college women who pursued science for two or more years later turn away from their science career aspirations? Images of lone voyagers, and how they are incorporated into one's self-image, may indeed influence whether college women pursue science careers. In this research project, we seek to understand how such images affect women's career aspirations, not so much in the abstract, but as they actually try them on for themselves. We believe that examining images of self in the future, particularly images of self in future careers can contribute to understanding changes in women's career aspirations.

Clash of Future Selves

We introduce the idea of clash of future selves to help make sense of the experiences of college women considering science careers. In a pilot study, Packard (1996) interviewed college women considering careers in medicine to understand the factors influencing their career aspirations. Although the interview addressed such topics as experiences in science courses or the change from high school to college science environments, the women raised another issue in their interviews: they could see themselves as physicians or as mothers in the future, but seeing themselves as both physicians and mothers seemed to clash. Hazel Markus' notion of "possible selves" helped

to place these data in the context of psychological theory. Markus and Nurius (1986) introduced the notion of possible selves, that self-concept does not exist only in the present tense. People have multifaceted self-conceptions that take the form of past selves, feared selves and hoped for selves. In particular, we have future-oriented selves which motivate our behavior. This notion of "possible selves" and the results from the pilot study provided support for our introducing the notion, clash of future selves, to help make sense of the experiences of college women considering science careers. We explore how women's experience of clash of future selves affects their science career aspirations.

The Pilot Study

Exploring the results from the pilot study (Packard, 1996) can help illustrate the language of the self and clash of future selves. Accounts of "the self" seemed to leap out of the women's stories. That is, they describe very vividly conflicts they have when considering these future careers in medicine. These clashes seemed to affect their career aspirations.

One woman's experience illustrated that she was not deciding about pursuing medicine based on her interests alone. She said, "The struggle with the classes made you start thinking about not becoming a doctor, but becoming older made you think about and realize what I wanted out of my whole life, not just out of my career" (25 year old, psychology graduate student, Sherri). A nineteen year old woman in her second year of college, Andie, emphasized fewer feelings of clash than other women interviewed, and was the most enthusiastic about completing her sequence. After working closely with her father, she reported that she did not imagine that other influences such as getting married would prevent her from realizing her career goals. She said, "I'm not going to base my decision on anything like that." However, four months later she reported that she was having doubts about pursuing medicine even though she was close to completing her preparation

sequence. She said, "I don't think I am going to finish the premed sequence. I am just not as money hungry as my dad. I was thinking that I will apply for PA schools."

Two women who were in later stages of college described their perceived conflicts when envisioning lives as physicians and having personal lives as well. "That was a dream of mine since the sixth grade and which is one of the reasons why it has been so hard to give up...it's not that I could have children or a family but not to the extent I think a family should be" (Sherri). Another woman said, "I just wasn't sure if my main interest was in that field or if my main interest was having kids you know that was a dilemma that was going through my head...I think the biggest part has been the time constraints if you think you are not going to have a life besides the career." (21 year old, college senior, Ali).

In these excerpts, women discuss wanting to become mothers and wanting to become physicians. The further they became invested in pursuing careers in medicine, the more they thought about what they wanted from their whole lives. We wanted to continue research in this area to explore how these clashes influence career aspirations. First we will examine how the research literature can help make sense of why these women experienced clashes, by examining the nature of these clashes.

The Nature of Clashes

Negative Consequences to Their Relationships With Others

Many women may experience feelings of conflict when envisioning themselves in a future science career because of the perceived impact that will have on the relationships in their personal life. Gilligan's (1982) research on women's moral development provided insight for ways women may decide about careers based on factors other than interests or competence in the field. Gilligan found that women often made decisions while seeing people in a network of relationships. Instead of viewing individuals as isolated units, they discussed the potential consequences of one individual's actions on someone else. Women may consider how relationships may suffer as a result of pursuing certain science careers;

this is a potential reason for why women may experience feelings of clash when envisioning themselves in future science-related careers. Clashes may arise when imagining the negative consequences the career will have on relationships with others. Another related clash women may experience is imagining themselves as professionals in science who are isolated or too busy for their families because they are so consumed by their work.

Images of Isolated Professionals in Science who are Consumed by Their Work

Stage and Maple (1996) interviewed graduate women who turned away from math careers after completing at least an undergraduate degree in mathematics. Images of mathematicians reported by the women were often negative, and were associated with being isolated. Documenting these negative images can help understand why some women feel clash of future selves. For example, some women in this study found difficulty in conceiving of themselves as women, mothers, wives, and mathematicians. In addition, many of the graduate women they interviewed had no idea as undergraduates what they might do with their degree in math besides being a teacher or an actuary (and they did not know what an actuary did). Their limited notions of future careers may have encouraged them to rely on stereotypes to fill in the gaps of knowledge.

Eisenhart, Finkel, and Marion (1996) builds on this point by stating that underrepresentation of women and girls in science is influenced by the mass media's stereotyped portrayals of scientists as "nerdy, male and White" (pg. 272). Frieze and Hanusa (1984) describe this clash as choosing between being "feminine" or being "scientific". Mitroff, Jacob & Moore (1977, cited by Frieze and Hanusa) reported that stereotypically, scientists are perceived to spend long hours in a lab, a perception that may lead women to believe they would have to sacrifice social interaction. For many students this may present a strong clash of identity if they feel they are too different from the images of this career.

Research in professional contexts have documented that professional labels, such as "Techies," are often incorporated into people's identities (Kunda, 1992). Women who are considering science careers may find it difficult to incorporate professional labels into their self image if their conceptions of scientists are stereotypical. For example, common perceptions of the man in a white lab coat locked away in his solitary lab, and the doctor who is a slave to the hospital and always "on call" that are persistent in society may influence women's career aspirations.

How People in the Science Field Influence Images and Their Development

We have given examples illustrating how media and stereotypes inform women's science career images. In addition, women's examinations of individuals in science communities may inform their career images. What exactly do they look for and how are their images informed through interactions with others? Other people (e.g., peers, parents, mentors) influence the development of these images because they provide examples of people in the career. As Gilbert and Rossman (1992) wrote,

> Women today are struggling to define themselves and to create new images of themselves as women, ones that allow a number of different patterns, ranging from the integration and coexistence of achievement and family life to the choice of one over the other (Baruch, Barnett & Rivers, 1983). A number of studies of graduate students in psychology concluded that female students were looking for other images and alternative destinies for themselves and were looking to the lives of other women for evidence of other possible selves (e.g., Gilbert & Evans, 1985; Pierce, 1984).

By examining the lives of other people such as peers, mentors, and professors to inform the images they have for future careers, they may subsequently try on these images for themselves as they consider science careers. Reinharz (1979) said, "As soon as the fateful choice was made [to become a sociologist], I began to examine my role models-- Mirra Komarovsky, Renee Fox, Phillip Zimbardo, Alan Blum, Roberta Simmons, Gladys

Meyer, and Amitai Etzioni among others. These were the people who represented the 'future me'" (pg. 51). Depending on the role models available to women, these images can be based on stereotypes or relationships to real professionals in the field. This research examines how women's relationships with people in science inform their career images and affect their science career aspirations.

How Prior Research Has Addressed Women Leaving Science Pipeline

For decades researchers have examined reasons why fewer women are found in the science "pipeline"; Eccles (1987) studied the decline of girls' interests in junior high, Baker (1987) studied high school women's views of themselves as science students, and others have studied the function of peer socialization in college women's career-related decisions (Holland & Eisenhart, 1990). Although this research adds to our understanding of underrepresention of women in science, there has been a lack of research dedicated to tracking women as they leave the science pipeline, particularly in the later years of college when students are more likely to be seriously considering careers.

Losing interest in science, although commonsensical, may not be the reason some women use to explain their departure from science careers. Lips (1993) found that college men's self-described interests in physical sciences were predictive of their perceived strong likelihood to pursue a career in the field. However, women's self-described interests in science were weakly related or not related to their perceived strong likelihood of pursuing a career in science. Lips suggests that other factors besides self-perceived interest are critical in students' career choices. The current research explores the possibility that clash of future selves is a conception for why women with strong interests in science and who have made strong investments in science do not pursue science careers.

One conception of why women leave science during college that has been supported in the research literature is the unfriendly, competitive, disconnecting atmosphere stereotypical of science classrooms. Eisenhart et. al (1996) reported in their review of the

literature that students may feel disconnected to science classrooms and the content taught in them due to their "chilly climate" (e.g., Tobias, 1990; Sadker & Sadker, 1994). This research project will address women's experiences in science courses to see if they describe the chilly climate as having affecting their career aspirations. Because the chilly climate is used more often to describe precollege and introductory college science courses, the chilly climate may not be the only reason used to explain their departure because the women studied in this research have already surpassed introductory courses. Given the dramatic nature of their decisions to switch career aspirations after such an investment in preparing for a science career, this project serves to explore other conceptions for these women's decisions.

Focusing on the Self Can Contribute To Understanding Experiences of Target Population

The current research project is a continuation of research examining why women "turn away" from science during college. Research in this area can contribute to the broader research literature because it is different from research on students who have not expressed interests in nor made investments toward pursuing science careers. Turning away refers to when women who have exhibited interest and success in science (through taking courses and expressing interest in a science career) switch college majors and change career ambitions, thereby turning away from their initial science-related careers. As explored by Tobias (1990), students who are smart, competent, and motivated and succeed in other areas may never enter science careers because they are not engaged by science, particularly in the introductory sequences. However, many participants in Tobias' (1990) work had not made a significant investment toward pursuing a science career at any time in college (which is why they had not taken an introductory science course until their participation was solicited by Tobias). Participants in Tobias' work could be thought of as turning *toward* another career rather than turning *away* from science. In the current research, it is anticipated that women experience a conflict because the women have pursued science for

many years until they dramatically change career aspirations during their last years of college. This research thus explores the notion that women are turning *away* from science rather than turning *to* another field noting that some change has occurred. There is a lack of previous research that has examined the experiences of students who make such an investment toward a science career and eventually leave the science pipeline; in this project women who have recently left the science pipeline are interviewed to further understand their experiences.

Another limitation of prior research is the lack of emphasis on images of self and their influence on career aspirations. Our research explores the experiences of these women considering science careers to see how they explain their departure from science careers and also their pursuit of such careers. How do they discuss their career aspirations-- in terms of interests, grades, or climate? Because the women in this research project had made such an investment (two or more years) toward a science career, persisting beyond introductory science courses, we expect that exploring issues of the self in addition to the factors explored in prior research will contribute to our understanding of the factors influencing their career aspirations.

Research Questions

This research seeks to explore why these college women turn away, sometimes dramatically, from science careers they aspired to, and how their experiences are similar to and different from women who are still pursuing science. Specifically, 1) What is the nature of any clashes these women experiencing when considering science careers in the future and how do they affect their career aspirations?, and 2) What differentiates the experiences of the Switchers and Pursuers? Switchers and Pursuers are used when discussing the participants. This terminology is preferred over the "science career persister-nonpersister" terms that are more commonly used. Persistence tends to a positive connotation and thus nonpersister has a negative connotation; "Switching" more accurately

denotes the "turning away" phenomenon that was discussed in the introduction without adding any negative value judgment to their decisions. Likewise, "pursuing" describes the other women's current states-- that they are pursuing a science career.

Method

Participants

Participants were college women attending a large midwestern university. The women ranged in age from 20 to 23 years old.

Procedures

Instructors of undergraduate and graduate courses were contacted to ask permission to solicit volunteers from their courses by distributing a short survey assessing students' college major since attending the university. Potential participants completed the survey and indicated that they were willing to be contacted to schedule an interview. Five college women who were majoring in science and planned to pursue a science-related career (e.g., medicine, genetic research), and five college women who had pursued a science career for at least two years but later changed career aspirations were interviewed. Interviews took approximately one hour and participants were compensated a nominal amount for their interview time. The semi-structured interviews (see Appendix A for interview protocol) were audiotaped. Audiotapes were transcribed and analyzed.

Results

Overview

First, descriptive information about each group is presented (e.g., years invested in science and careers pursued). Next, summary information about the women's experiences is presented for all participants (e.g., who had a parent, mentor, or work experience in science). Finally, to expand upon results in these sections, examples from the women's interviews are presented to offer a flavor of what the women said in their interviews, in terms of using language of the self, clash of future selves, and negotiations of clashes.

Information by Group

Information about participants are displayed below (see Table 1a and 1b), with information about Pursuers and Switchers displayed separately. Short case summaries are available (see Appendix B). Notice that all participants had invested between two and four years in science. Most described themselves as doing well in their courses. The grade point averages that were available are displayed in the table. In this overview, participants appear basically comparable across groups.

Table 1a: Pursuers

Name	Cameron	Autumn	Dawn	Jessie	Stephanie
Years Invested	3 years	4 years	3 years	4 years	3 years
GPA	3.65 overall 3.5 science	3.85 overall 3.8 science	3.8 overall 3.9 science	3.1 overall 2.75 science	3.66 overall science n/a
Career currently pursuing	Veterinarian	Physician	Researcher	Chiropractor	Physician

Table 1b: Switchers

Name	Elizabeth	Kari	Shelly	Betsy	Allison
Years Invested	2 years	4 years	4 years	3 years	3 years
GPA	3.7 overall, 4.0 science	"did well" specific n/a	"did well" specific n/a	3.75 in ed. 1.5 science	3.6 overall 3.5 science
Career before switching	Environmental Scientist	Physician/ P.A.	Airforce (Science)	Marine Biologist	Mechanical Engineer
Switched To	English	HS Biology Teacher	HS Biology Teacher	Elementary Ed. (Nonsci)	Elementary Ed. (Sci)

Information across Participants

Next, information for all participants are listed in one table (see Table 2). The table indicates whether participants spoke of having a mentor in science (e.g., a family friend, professor or physician they worked with), work experience in science (e.g., working in a research lab), an influential elementary or secondary teacher as a role model (e.g., someone in their educational experience or else as interns), and their peer group in science.

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Table 2: Summary of Experiences (P=Pursuer, S=Switcher)

Name	Science Mentor?	Science Work Exp?	Influential Teacher?	Parent in Science?	Science Peers?
Cameron (P)	x	x		x	x
Autumn (P)	x	x		x	x
Dawn (P)	x	x			x
Jessie (P)	x	x		x	
Stephanie (P)	x	x		x	x
Elizabeth (S)			x		
Kari (S)		x	x	x	x
Shelly (S)			x		
Betsy (S)			x		
Allison (S)		x	x	x	

Pursuers were more likely to have a mentor, parent, peer group, and work experience in science whereas Switchers were more likely to mention an influential elementary or secondary teacher they had in their educational experience. These elements will continue to be highlighted in the next section where excerpts from interviews are presented. Three themes from the interviews are presented, with excerpts from interviews: language of self, clash of future selves, and negotiating clashes.

Language of Self

Language describing images of self in the future helps show why people switch and also why they stay. Women noticeably used language of "self" (e.g., "I see myself", "That's just not me") to talk about their experiences and decisions surrounding careers. Language of the self helps show why people turn away from science careers and also why they choose to stay. Examples from the interviews illustrate women using language of the self, providing compelling support for following this line of inquiry (see Table 3). Notice how they use language when reading these excerpts.

Table 3: Language of Self

Pursuers	**Switchers**
Can you think of an image of a vet...how do you see yourself as similar or different? My father comes to mind almost immediately, but there's also my grandfather too...Yeah I guess I see it as someone who has his job and it comes home with him but he likes his job so the fact it comes home with him doesn't bother him...**I see myself** easily fitting into that because I have all my life. (Cameron)	*You talked about the competitive classes, the classes you took, especially in NY, were the classes competitive or were the people competitive?* I think the people who are premed or hard-core science, I guess just by nature, they have to make the grade. And if you have to step on Joe Schmo to make the grade well that's okay. And **that's just not me**. (Kari)
Can you take your image of a doctor, and of yourself, and tell me any similarities or differences? I want to have the option, as I have gotten older I have realized I don't want to eliminate the chance of having a family, I want to have a well-rounded life, which is something I don't see in research...I think I will have control over my own work. This person? It requires long hours, it requires, I think sacrifice, self-sacrifice, your life will revolve around your career, and **I can see myself** living with that. (Stephanie)	*The money wasn't a factor?* I would rather be happy than have all that money...I hated everything you had to do to prepare for it, networking, I hate doing that, people would all be schmoozing, and **I am just not that type of person**, and people would say, "you gotta do it." (Allison)

When reading these excepts, one gains a sense of how they use language of the self to discuss their career aspirations and how they see themselves fitting into career images. These examples give a flavor of the language they used and also how the women seem to be trying on these career images for themselves as they look within the science community. The next section further illustrates this when describing women's experiences of clash of future selves.

Clash of Future Selves

Clash of future selves helps to understand why these women do not continue to pursue certain careers, such as medicine or research science. Women use language of the self to describe images of others in the field and appear to be "trying them on" for themselves (see Table 4). When reading, notice how both Pursuers and Switchers describe clashes they are experiencing when envisioning themselves in these future careers.

Table 4: Clash of Future Selves.

Pursuers	**Switchers**
Are you happy with what you know (in research)? The research I am doing; I like doing it (pause) but there is something lacking. It is not hands on enough for me. **I cannot see myself doing it for the rest of my life**, at least not in this capacity, not how I see graduate students doing it. I am also looking at it, going, part of the reason why I chose vet school is **I'm looking at the grad students** and I am thinking, I don't want to be 28 years old and still trying to get my Ph.D. in biochemistry (Cameron)	*What kind of advice could you give [a woman interested in medicine]to help her ?* **I just think medicine becomes your life**...so you are looking at 12 or 13 years that you are **devoting to medicine and not your family.** *(Don't you think you have to give a 100% in teaching?)* But in teaching they don't call me at 2 in the morning and say I really have a problem with this lesson plan, could you come in? When 3:30 or 4 o'clock rolls around I can go home if I want. I don't have to stay there. If I am a physician, and my patient is dying, I can't leave. But yet my son or daughter might be in a recital and I am going to miss it. (Kari)

What do you think about a career in research? Honestly, I don't know if there's enough people around, the reason why I like health care is that I like a lot of people coming in and out of my office and I don't think that would happen with research. *Why do you think that?* **I have these pictures of research people**, when I work at the Science Building, **there are some weird people, you know they don't go home**. I want to have my career and I want to have my life too. (Jessie)	*Could you talk about what interested you in science, and would you say you lost your interests in science?* Ummm no not at all. I have a more social interest in science, more like natural resources and things. **I can't see myself you know maybe working in a lab by myself with these little vials and not connecting with people**. If I could protect natural resources and work with people that is why I was interested in biology to begin with. (Elizabeth)

These excerpts illustrate women's experiences of clashes, ranging from seeing research as requiring isolated "weird" people working with "little vials". In addition, becoming a physician creates an image of being called in at all hours and not devoting life to your family. Interestingly, both Pursuers and Switchers had images of careers in science that influenced them to experience clashes when imagining themselves in that future career. If both Pursuers and Switchers speak of the self when discussing career aspirations and both experienced clashes when envisioning science careers, what differentiates their experiences?

Negotiating Clashes: Mentors Provide Visions of Possibility

One important different between these women's experiences becomes clear when examining Pursuers' interactions with mentors (see Table 5). Mentors seemed to provide visions of possibility to the Pursuers that helped women to negotiate clashes they were experiencing. Pursuers negotiated clashes they felt in medicine and research science through conversations with and the example set by their mentor, role models, others in their networks of support (including parents and peers) leaving them feeling supported and

their presence in the field validated. Switchers usually did not have these mentors or parents in science, nor peers or a network of support who could potentially help negotiate feelings of clash and help validate their presence in the field. These excerpts demonstrate that it is not simply either having a mentor or not having a mentor but rather the act of negotiation that was helped by the mentors.

Table 5: Negotiating Clashes

Pursuers	**Switchers**
But you had professors in classes that were not that good, you were turned down by a family friend to work with, what kept you going? I don't know, especially when the doctor (male family friend) told me no, I was really discouraged. *What will be the biggest struggle?* **I think the biggest struggle will be balancing the patients and balancing the family...The physician I worked with that summer she was incredible, she sat me down several times and said this is what you are getting into.** I want to lay this all out on the table for you. I am a female in medicine, I have a family and I don't get to see them very much. Here is how much time I am devoting to my work, and here is how much time I am devoting to my husband and child. **And I just want you to know everything before you get into this, it is manageable but it is hard work.** (Autumn)	*What do your friends think about you as a teacher instead of a marine biologist?* I think they always thought I would be something normal like a teacher because they don't see marine biology as normal. When I see them now, they ask what I am doing, they say oh you are not in marine biology, and they just kind of chuckle. *(How does that make you feel?)* In a way it ticks me off because I really was serious about it. **In a way I think how could I really have ever been serious about it? If they view me that way and they thought it was that funny the whole time, what was I thinking even trying it, you know?** I think more often than not, it ticks me off because I really do feel strongly about it, **and really do wish that I had kept on and just been like I don't care what you people think I am just going to do it**, despite the experiences I have had with you. It can go either way with insecurities because I feel like I haven't accomplished my goal. (Betsy)

I had the hardest time getting letters of recommendation from him (male advisor), he ended up refusing to write them for me for graduate school... *How do you keep going when you get frustrated?* **I have a lot of other people I can go to, I have my mentors in the lab**, I have other advisors, they help out, they say this isn't appropriate, or they talk to them or they fix the situation, but I shouldn't have to worry about it that this shouldn't have happened but I am lucky to have a network of other people when things go wrong. (Dawn)	Ever since I was a little kid I have also always wanted to go into the air force. I wanted to go in after high school for some reason the recruiter didn't like me-- he would make appointments with me at my house and not show up. *Has there been somebody who really stands out in your mind who...anyone you worked with at all?* I really can't think of anybody. *Do you use the word mentoring?* I really don't think I have ever had one. I have always just wanted myself to do well. **I just don't have a mentor.** (Shelly)

These excerpts illustrate the women's struggles dealing with being women in science fields, facing rejections from male advisors and recruiters, others not believing in them, and struggling with how to balance family and careers. Pursuers faced rejections as well but they had other people to go to-- mentors in the lab for Dawn or a woman physician Autumn eventually worked with-- to help them negotiate clashes (such as believing they will be isolated/rejected, or not be able to have family and a career). The Switchers on the other hand were left with these aspirations still strong inside but did not have others validating their presence in the field or helping them to negotiate clashes they experienced (feeling that they were so "different" they did not belong in the field). The passion of their words and the power of these clashes of self came through in their interviews as strongly as the power of the negotiations with mentors.

Discussion

Images of self in future careers provide valuable information when understanding the experiences of women considering careers in science. Clashes of future selves is a useful notion for understanding why women change career aspirations and also why they choose to stay. Both Pursuers and Switchers used language of the self and described clashes of future selves. Relationships with mentors (or lack thereof) affected the experiences of all of the women. This study shows a dramatic difference in their experiences was the resolution of clashes for Pursuers through discussions or advice or examples set by mentors/role models in their science experiences.

Pursuers could see themselves fitting into their career as a professional in science. The Switchers, on the other hand, did not feel similar to their peers in science nor did they have a relationship with a mentor in science. Thus, when faced with doubts or conflicts, there was not someone there to tell them they belonged in science or help them negotiate the clashes they experienced. Their excerpts showed that they believed that they could not go into particular science careers without having doubts about belonging or feeling they would have to sacrifice their family or personal life for the career.

An interesting observation was that Switchers mainly switched to education/teaching in some capacity and they mentioned having role models in that field. This potentially supports the power of feeling a part of a community and having role models whom you identify with. Others who have lives like you would like or else help you negotiate your concerns with the career you aspire to can be valuable in retention efforts.

This project expands on the results from prior research. These results indicated that Switchers did not lose interest in science. They in fact spoke enthusiastically about their strong interests in science. Thus, not all women who leave the science pipeline do so because they lose interest in science. But, they did have conflicts with the career images and what life would be like as someone in that career. Results indicated that Switchers

indeed experienced a chilly climate. But more specifically, they did not feel a part of their science community, and did not feel similar to their peers and professors.

Contrary to some common conceptions, Switchers did not use their performance in courses to explain their departure. In fact, many of the Switchers were doing well in their classes. This provides more support for alternative explanations for why women turn away from science, namely, examining the role the self plays in their career decisions.
Four of the five women specifically mentioned possibly coming back to science in the future. Thus, this conception is not strongly supported by these results.

Implications

Interventions Involving Mentors and Multiple Images

Interventions that 1) expose women to multiple images for people in science careers, 2) give opportunities to see how women in science or medicine negotiated some of these clashes, or 3) offer opportunities for women to develop relationships with mentors or otherwise gain valuable work experience in the context of a research team or other community of science professionals would seem to be important for women as they delve deeper into a commitment to science career. These interventions could be targeted in the second or third years of college, when women may be contemplating turning away from science.

Guidance Counselors or Academic Advisors

Not all Pursuers had always wanted to do the career they were pursuing. In fact, a few discussed other possibilities that would have been along the lines of what they would want in a career but they either lacked the prerequisites to pursue it since they did not have the career information early enough to be prepared. There was a resounding negative or neutral feeling towards guidance counselors and academic advisors from both groups of women. While many of the Pursuers had family contacts or early support systems by means of a research team or mentoring program, many of Switchers did not. In fact in

these interviews, the women more often had to really think about anyone who had been influential in their career planning. And more often this would be an elementary school or high school teacher who had been the last really influential person in their science career aspirations-- the same careers these people opted to switch to. In fact the most influential people for these Switchers were teachers-- not from college-- but from their early years, people they could want to follow in their paths. More sensitivity and awareness on the part of guidance counselors and academic advisors is necessary.

Future Research on Images of Self in the Future

Further research should follow individuals as they leave the science pipeline and document the reasons they use to explain their departure. Future research projects can investigate the particular modeling and mentoring processes involved in successful mentoring. In addition, it is important to further study the processes involved when women compare themselves to others in the field and to see how they try on such images particularly when their information about careers or connections to professionals in the field are limited. Through understanding how these images of future careers are formed, how individuals interact and learn from mentors, and how clashes of self are negotiated, we can learn more about women's underrepresentation in science as well as about potential interventions.

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Appendix A. Interview Protocol

General questions
What are your career aspirations?
What made you decide to (switch out of/stay with) science?
How did you decide you wanted to be [the science career]?
Where did you get your career information?

Courses
How much of your decision has to do with your experience in courses?
If you can distinguish between science courses and format and science subject matter, could you talk about your experience with science subject matter?
[Do you feel you have a handle on the content? connected?]
How do you feel about science subject matter compared to other subjects?
How is the teaching alike or different in science compared to other courses?
What words or phrases come to mind when you envision the science field?

Supportive People
Which people have been supportive in your career aspirations?
Do you have a mentor in this field? [Is that person a role model?]
Can you talk more about your relationship with them?
[How have they been positive? Do you identify with them?
How do they support you? Have you worked with them?]
Can you think of someone who fits that description, and talk more about how you see yourself as alike or different from them?
Have you had any significant negative or positive experiences with people in your field that stand out in your memory, such as with one of your professors?
Have you gained work experience in your area?

Personal Aspirations
What do you envision yourself doing in the future?
(e.g., children, marriage, becoming a professor)
Do you anticipate any conflicts in achieving these visions in your future, or do they look pretty consistent to you?
Have your decisions to switch to another field been influenced by what else you want for yourself in the future? Can you talk more about how you planned to balance these things?
[Other people just like you have felt these things, but they turn away from science, why do you think they do that?]
Have your peers supported your science aspirations?
What do (did) they think of you as [chosen science career]? How about as something else (new field)?
How about Your parents? What do they think about your new career aspirations?

New field vs. old?
I am sure everyone considers other fields. Can you talk more about other careers you have considered and why the one you have chosen is more appealing to you?
What makes the science career different than other careers?
Do you envision any problems in the workplace (discrimination, not being supportive of having children)? If yes, how do you plan to handle that?
What benefits do you expect from your career?

Appendix B: Short Case Summaries of Participants

Pursuer 1: Cameron
Cameron described her family of veterinarians, namely her father and grandfather. She immediately mentioned the research she has been involved in for the past three years, and how she had a strong relationship with her mentor. With her research experience and five years of experience working in her father's clinic, she feels very confident about her becoming a vet. She considered research in biochemistry but does not want to be 28 and still pursuing her Ph.D.; she said she likes the benefits of becoming a doctor after four years and how it will be flexible for having a family. As she said, she has grown up with the rigor and schedule that a vet has and she can see herself fitting into that.

Pursuer 2: Autumn
Autumn came into college knowing she wanted to be in science but was not thinking about becoming a doctor. She liked the challenge of the research in her labs (from classes) but she needed more people interaction. Her friends were premed and so she considered becoming a doctor since she was already majoring in science. After a discouraging incident where a family friend turned her down for a summer internship, a new woman doctor in her town was more than willing to work with her. She worked very closely with this woman, who went out of her way to talk to her about being a woman and a doctor. Autumn was concerned about having a family and being a doctor but she says that this woman's advice along with talking to her mother about the value of an education really helped her. These experiences and her experience of working in a hospital solidified her commitment toward becoming a physician.

Pursuer 3: Dawn
Dawn spoke almost immediately about her mentor in her research lab. Dawn began doing research her freshman year and has worked with a woman who spent extra time getting her up to speed in the lab and has answered any questions that she has had. Her enthusiasm when talking about the discovery in research was powerful. She had considered doing research with plants but decided she needed to use science to help people. This is why she mainly became interested in human genetics research. Although neither of her parents are in science, they have been really supportive of her interests. Her interests were sparked when she went to this summer program in high school on genetics and she talks about Barbara McClintock as being a good role model for her.

Pursuer 4: Jessie
Jessie's interests in chiropractic medicine were sparked by a visits to a family friend who is a chiropractor. She knew she would go into science, especially biology, because her personal interests and her science interests are very similar. Many of her friends left science and she has had some struggles in her classes. However, her father, an engineer, told her that he too had struggled in math and science but now she has seen that he is very successful, and this encouragement helped her see that much learning occurs on the job later. Jessie seems very concerned about how to balance a family and her career; although she feels close to this family friend she is searching for a woman chiropractor so she can find out how women manage this. She also seemed to be contemplating biology research. The dream job she described comes from a movie about a man who does research in the rainforest looking for a cure for diseases. She plans to do research before she goes to chiropractic school to rule out that the job would indeed be too monotonous for her.

Pursuer 5: Stephanie
Stephanie describes her work in a biochemistry laboratory. She fondly speaks of her mentor, a woman who recently received her Ph.D. in biochemistry. However, Stephanie perceives this mentor to be "different" from others in science and this relates to is why this

mentor has struggled so much in the field. Her boss in the lab who is consumed by his work demonstrates the life of a scientist. In her eyes a good scientist is someone who cannot have success at work and at home at the same time. Her father, a physician, has shown her that a physician has more control over the hours devoted to the field because she would be compensated financially for her time.

Switcher 1: Elizabeth

Elizabeth described her deep interests in the environment in her interview. As an environmental scientist, she wanted to write and publish what she found, not spend so much time out doing field work. However, she says that she would like to find a way to combine English and science; she is quick to tell me that she may return to science one day after she completes her BA. Without a mentor or parents in science, she did not have actual interaction with an environmental scientist. As she said, it was not a particular person but rather a social interest in science that influenced her to initially pursue environmental science. She is not particularly sure what she can see herself doing with English, perhaps teaching, even though she said she never envisioned herself as a teacher.

Switcher 2: Kari

Kari spoke about needing to choose a career. She did not want to wait five years for PA school and she did not feel she could be as dedicated as needed for medicine. When asked about a career in medicine, she believed that one needs to put life on hold for ten years at least and if someone is not willing to do that, then they should choose another career. Both of her parents are chemists yet she had never been to work with either of them, nor can she cannot speak of a mentor in science. She spoke of experiencing a traumatic first year of college in the premed sequence. She felt that the premeds are very competitive and they step on people if necessary, and she is not like that. Overall, she seemed to be very happy with her choice of teaching because she feels her personal goals are the same as the goals she has as a teacher.

Switcher 3: Shelly

Shelly opened her interview describing how she has always wanted to be a teacher, from the time she was younger. She found her college science classes to be too large and she felt overwhelmed by the premed people who stuck together. An important factor in her educational trajectory is financial support since she has to support her own education. Thus, she never really considered medicine because of the financial burden she had already incurred from undergraduate expenses. Near the end of the interview, she revealed that she had always wanted to go into the airforce for science since she was young. However, after high school when she wanted to enlist, a recruiter would not show up for her appointments and in college ROTC took up too much of time (she needed to spend that time working). At this time she is planning to enter the airforce for a couple years, after completing student teaching-- before beginning her teaching career. However, she is not receiving support from peers and others who have always seen her becoming a teacher and who do not understand her need to do this.

Switcher 4: Betsy

Betsy described teaching as her second choice to marine biology. She did not feel that she was a "superteacher"-- in fact she felt her lack of ultimate enthusiasm may be inadequate for her students. She had always wanted to be a marine biologist and speaks painfully about the poor guidance she received from the academic advisors, how she was passed over by her professors, and how even her peers never took her serious. She still envisioned an opportunity to go back to school for marine biology at another time; receiving a degree in education if anything could help facilitate that move for her. Her enthusiasm and obvious zest for marine mammals made her believe that she was aspiring to the right field-- she was

consumed by the idea of marine life and research. However, she said she was unlike marine biologists because they want to do "the whole thing" referring to the struggle and defeat of the path to that career.

Switcher 5: Allison

Allison declared engineering as her major because she was good at math and science in high school, not because there was someone she knew who had a job that she wanted to have. Even though her peers were not in science, she describes a very positive experience in her engineering classes, which involved extensive collaboration. During her engineering internship she realized what she would eventually be doing was a lot of "schmoozing" and business-- things she did not want to be doing that the rest of her life. Although she cannot say she has had a mentor in science, her father, a scientist, and her mother struggled at first to accept her decision to switch out of engineering. She finds herself to be much happier in elementary education where she has a chance to make a difference and do different things each day.